

## REMARKS

Claims 2, 3, 14, 20 and 37-44 remain pending for further prosecution in the present application and claims 21-25 are withdrawn as being directed to a non-elected species but remain in the application in the event that they can be re-joined. Independent claims 2 and 37 have been amended to distinguish over the prior art of record. No new matter was added. Applicants respectfully submit that the present application is in condition for allowance and rejoinder is respectfully requested.

### **Claim Rejections - 35 USC §103(a)**

- A. *In the FINAL Office Action dated May 19, 2010, claims 2, 3, 14, 20, 37, 38 and 42-44 are rejected under 35 USC §103(a) as being obvious over the publication of Fan et al. titled "Deformation behavior of Zr-based bulk nanocrystalline amorphous alloys" in view of U.S. Patent No. 4,992,095 issued to Nate et al.*

#### Fan et al.

The three page Fan et al. publication provides a brief discussion with respect to the mechanical properties of a pair of amorphous alloys, namely,  $\text{Zr}_{55}\text{Ni}_5\text{Cu}_{30}\text{Al}_{10}$  and  $\text{Zr}_{53}\text{Ti}_5\text{Ni}_{10}\text{Cu}_{20}\text{Al}_{12}$ . The deformation behavior of the alloys are studied and discussed relative to compression tests applied to specimens of the alloys. The specimens of both of the alloys are produced by means of melting and casting the alloy.

The  $\text{Zr}_{55}\text{Ni}_5\text{Cu}_{30}\text{Al}_{10}$  specimen is described by Fan et al. as having a "purely amorphous" microstructure manufactured by melting and casting raw materials. See page 3762, column on right, lines 8-10 underneath FIG. 2.

The  $\text{Zr}_{53}\text{Ti}_5\text{Ni}_{10}\text{Cu}_{20}\text{Al}_{12}$  specimen is described as having an "amorphous matrix" in which a small percentage of nanoparticles are embedded. (See page 3762, column on right, lines

1-4; and see page 3762, column on right, lines 5-7 underneath FIG. 2.) For example, Table 1 at the bottom of page 3762 discloses five different samples of the alloy with “different volume fractions of nanocrystals” embedded within an otherwise amorphous matrix material. More specifically, Table 1 discloses the alloy having 0%, 10% 16%, 28% and 43% fraction of nanocrystals. Thus, this alloy is essentially amorphous with a small fraction of “fine crystals” spaced-apart and embedded therein.

Nate et al.

Nate et al. disclose a “magneto-optical recording medium” having a composition that requires 10 to 50 atomic percent of a rare earth metal, 0.1 to 10 atomic percent of at least one additive element (with Zr being specifically referenced), and a balance of a transition metal.

The microstructure of the sputtering target body of Nate et al. (not to be confused with the microstructure of the thin film formed by sputtering the target material) is required to be a “mixed structure” of different phases of different intermetallic compounds. For example, see the “mixed structures” disclosed on column 2, line 65, to column 3, line 18, of the Nate et al. patent. This same disclosure is repeated in the Abstract and on column 2, lines 8-31, of the Nate et al. patent. For instance, Nate et al. state:

“The structure of the alloy target according to the present invention has (1) a **mixed structure** comprising a **phase of intermetallic compound** of rare earth element--additive metal--transition metal **and a fine mixed phase** of rare earth element and intermetallic compound of rare earth element--transition metal, (2) a mixed structure comprising a phase of intermetallic compound of rare earth element--transition metal, and a fine mixed phase of rare earth element and an intermetallic compound of rare earth element--transition metal (at least one of the rare earth element and the intermetallic compound in the fine mixed phase contains the additive element), (3) a mixed structure comprising a phase of intermetallic compound of rare earth element--transition metal and a phase of intermetallic compound of rare earth element--additive element, (4) a mixed structure comprising any one of the mixed structures of (1), (2) and (3) and a

phase of rare earth element alone, and (5) a mixed structure of any one of the mixed structures comprising a phase of intermetallic compound of rare earth element--additive element--transition metal and a phase of rare earth element alone.”

Thus, it is clear that Nate et al. fail to disclose a sintered compact of an amorphous state; rather, Nate et al. disclose a sintered body having a “mixed structure” of different phases of different intermetallic compounds, not an amorphous sintered body.

#### Patentability Argument

Applicants respectfully submit that independent claims 2 and 37, as amended, are patentable and are not obvious over Fan et al. in view of Nate et al. because the references fail to disclose the structure of the target as required by the claims, as amended. Applicants also respectfully submit that claim 44 is patentable over the cited references because a sputtering target of Fan et al. in view of Nate et al. would not be identical or substantially identical to that of the present invention and the same roughness limitation recited in claim 44 of the present application would not be "expected".

Claims 2 and 37 have been amended to require "a sintered body target structure having ... an ultrafine and uniform structure with an average crystallite size of 1nm to 5nm ... being of a state (or an amorphous state) in which a grain boundary is not observable and being without any crystal growth". No new matter was added. This structure is disclosed and explained on page 9, lines 13-20, of the present application, as filed, which states, as follows:

“The structure observation photograph of this target is shown in FIG. 1. In FIG. 1, a grain boundary is not observed (amorphous state), and the atomized powder is pressed as is and became a bulk body.

In order to confirm the amorphous state of the plasma sintered body, a sample was observed with the X-ray diffraction method. The half-power band width was 6.18° and the average crystallite size calculated with the Scherrer

formula was 14Å (1.4 nm), and it has been confirmed that the amorphous state was maintained even after the SPS processing without any crystal growth.”

The body of the target of the present invention is formed by pressing atomized powder such that no crystal grain boundary can be observed in the target structure of the present invention (i.e., it is in an “amorphous state”) as best explained on page 9, lines 13-20, of the present application, as filed. The target has "crystallites" providing the target with a fine and uniform structure and being of a size of 1nm to 5nm. However, no crystal structure exists across the target. The above referenced "amorphous state" refers to a state in which the "crystallites" are arranged without regularity and in which no crystal grain boundary can be observed.

The specimens of Fan et al. are formed by melting and casting, not by pressing powder. The first specimen of Fan et al. is without crystallites. The second specimen of Fan et al. includes "fine crystal grains" of a slight ratio embedded within an amorphous material. The "fine crystal grains" are spaced-apart and separated and a grain boundary is observable. See FIG. 2 of the Fan et al. publication.

The target of the present invention is in an “amorphous state” across the entire target and the crystallites have an ultrafine and uniform structure with an average diameter of 1 to 5nm (not a crystal structure). In contrast, Fan et al. disclose a specimen having "fine crystal grains" of a given small ratio embedded in an amorphous material such that the fine crystal grains are spaced apart therein. Thus, the structures of the target body of the present invention and the specimen of Fan et al. are clearly different. Applicants respectfully request reconsideration and removal of the rejection for at least this reason.

Further, Applicants respectfully submit that Nate et al. have been misinterpreted. Nate et al. fail to disclose a target structure of an amorphous state. Column 1, lines 18-35, of Nate et al. (cited by in the Office Action) discloses an amorphous alloy thin film, not a sputtering target

structure of an amorphous state. Rather, Nate et al. disclose a target for use in forming an amorphous thin film. However, the target structure of Nate et al. is clearly required to have a "crystal structure" based on an intermetallic compound phase. (See the Abstract, column 2, lines 8-31, and column 2, line 65, to column 3, line 18, of the Nate et al. patent.)

In sputtering, atoms are caused to be removed from the target and are applied to a substrate to form a thin film. While the composition of the thin film is generally the same as the composition of the target, the microstructure of the thin film is not necessarily the same as the target because the thin film is formed an atom or several atoms at a time. Here, Nate et al. clearly disclose the use of a target having a "crystal structure" based on an intermetallic compound phase. Thus, the target of Nate et al. is not of an amorphous state as required by the claims of the present application and as defined on page 9, lines 13-20, of the present application, as filed.

Accordingly, even upon combining Fan et al. and Nate et al., one of ordinary skill in the art would not find it obvious to produce the target required by claims 2 and 37, as amended, of the present application. Applicants respectfully request reconsideration and removal of the rejection for at least this reason.

Still further, claim 44 of the present application is rejected solely on the basis of the material of Fan et al. in view of Nate et al. being identical to that claimed. As described above, the materials, more particularly the microstructure, are not the same as that required by the claims of present application. Thus, Applicants respectfully submit that the limitation stated in claim 44 would not simply be "expected" from the cited prior art.

As explained in Applicants' previously-filed amendment, the microstructure of the present invention provides an unexpected result. As the target according to the present invention

is sputtered, its erosion surface remains smooth despite the progress of erosion thereby improving the uniformity of the thin film produced via sputtering and preventing undesired generation of arcings and particles that can be produced during sputtering. For example, FIG. 4 of the present application is a diagram showing the results of measuring the surface roughness of the target according to the present invention as sputtering progresses. In contrast, FIG. 8 is a diagram showing the results of measuring the surface roughness of a conventional target as sputtering progresses. With respect to the present invention, the surface roughness remains small during sputtering; whereas, the surface roughness of the conventional target increases to at least about 3.5 times greater than that of the present invention. From Table 1, on page 13 of the present application, as filed, the examples of the present invention have an erosion face after sputtering with a surface roughness of between about 0.12 and 0.34 $\mu\text{m}$ . In contrast, the surface roughness of the comparative examples is between about 0.87 to 3.52 $\mu\text{m}$ .

The cited references fail to disclose this unexpected result or provide any teaching with respect to this unique property of the present invention. Thus, Applicants respectfully request reconsideration with respect to the patentability of claim 44 relative to the cited references.

Accordingly, for all the reasons discussed above, Applicants respectfully submit that independent claims 2 and 37 of the present application, as well as dependent claim 44, are not obvious over Fan et al. in view of the Nate et al. patent. Applicants respectfully request reconsideration and removal of the rejection.

- B. *In the FINAL Office Action dated May 19, 2010, claims 39-41 are rejected under 35 USC §103(a) as being obvious over the publication of Fan et al. titled "Deformation behavior of Zr-based bulk nanocrystalline amorphous alloys" in view of U.S. Patent No. 4,992,095 issued to Nate et al. and further view of the publication of Kakiuchi et al. titled "Application of Zr-Based Bulk Glassy Alloys to Golf Clubs".*

Applicants respectfully submit that dependent claims 39-41 are patentable over Fan et al. in view of Nate et al. and further in view of Kakiuchi et al. for the same reasons discussed above that independent claims 2 and 37 are patentable over Fan et al. in view of the Nate et al. patent.

Accordingly, Applicants respectfully request reconsideration and removal of the rejection of claims 39-41.

### **Conclusion**

In view of the above amendments and arguments, Applicants respectfully submit that the rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

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